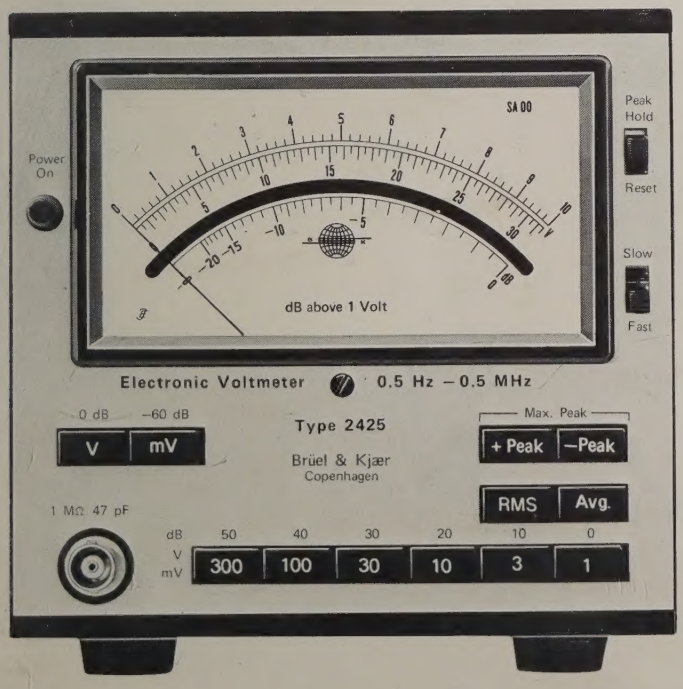
2425

Instruction Manual

Electronic Voltmeter Type 2425



A mains or battery operated precision instrument, measuring true RMS, Average, + Peak, — Peak, or Max. Peak voltage levels from 100 μV to 300 V over the 0,5 Hz to 500 kHz range.

Brüel & Kjær

033—0204

ELECTRONIC VOLTMETER
TYPE 2425

Revision March 1981

This apparatus has been designed and tested according to Class I of IEC Publication 348, Safety Requirements for Electronic Measuring apparatus and has been supplied in safe condition. The present instruction manual contains information and warnings which shall be followed by the user to ensure safe operation and to retain the apparatus in safe condition.

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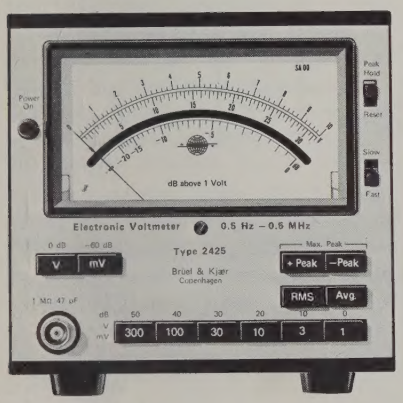
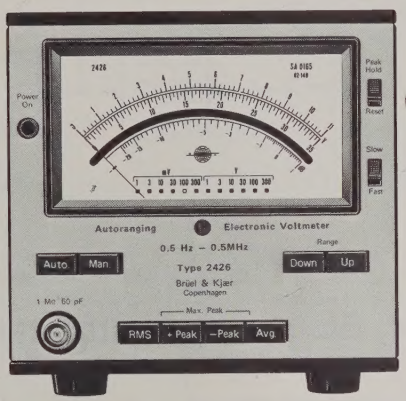
types 2425, 2426 and 2427

Electronic Voltmeters



2425



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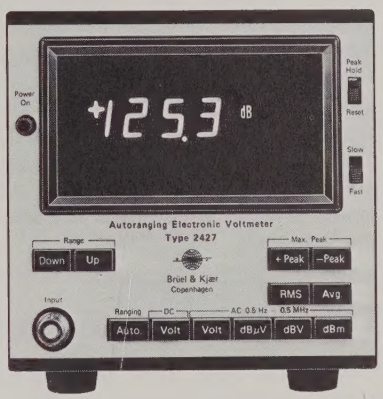


2427

COMMON FEATURES:

- True RMS detector with 40 dB range
- Crest Factor of 5
- Average detector
- + Peak, —Peak and Max. Peak detectors, rise time 50 μs
- Peak Hold function
- Wide frequency range 0,5 Hz to 0,5 MHz
- Indication of Volts, dBV and dBm
- Two built-in meter time constants
- Sensitivities from 1 mV to 300 V FSD
- Calibrated amplifier
- AC and DC outputs
- Input for external meter time constants

ADDITIONAL FEATURES 2425:

- Conformity to VU-meter standards
- Mains or external battery operation

ADDITIONAL FEATURES 2426:

- Automatic range selection
- Range indicator lamps
- Binary input for external range control
- Conformity to VU-meter standards

ADDITIONAL FEATURES 2427:

- 3 1/2 digit display
- BCD output of reading
- DC range from 100 mV to 400 V with indication of sign
- Automatic range selection
- Variable display rate

USES:

- Voltage measurement of —Peak, + Peak, Max. Peak, true RMS and Average values
- Calibrated amplifier
- General purpose EVM
- VU measurements (2425 and 2426 only)

Electronic Voltmeters Types 2425, 2426, and 2427 have the same basic functions with similar specifications. They differ mainly in read-out and range selection. Each has a true RMS rectifier with dynamic range of 40 dB and crest factor capability of 5 (14 dB), permitting measurement of complex, distorted and phase shifted signals. An average detector is included which with Voltmeters Types 2425 and 2426 conforms to standards for VU measurements. For measurement of impulses and other types of transient signal there is a peak detector which can detect signal peaks as short as 50 μs and has positive

peak, negative peak and maximum peak modes. There is also a hold mode where the display holds the peak value of a measured signal after the signal has disappeared from the input of the Voltmeters. This enables very short single impulses to be measured.

The Voltmeters have a wide frequency range which is linear to within ± 0,5 dB from 0,5 Hz up to 0,5 MHz, and use fixed gain amplifiers to ensure constant phase characteristics in all ranges. They are equipped with AC and DC outputs which are well suited for connection of a level recorder and enable them to be used as calibrated amplifiers.

Type 2425 Electronic Voltmeter

This is an AC Voltmeter with moving coil meter and manual range selection. Ranges are selected by means of push buttons arranged in 10 dB steps over a 110 dB range from 1 mV to 300 V for full scale meter deflection. Interchangeable scales are available which are calibrated for dBm and VU measurements. An external battery or AC mains supply may be used to power the Voltmeter.

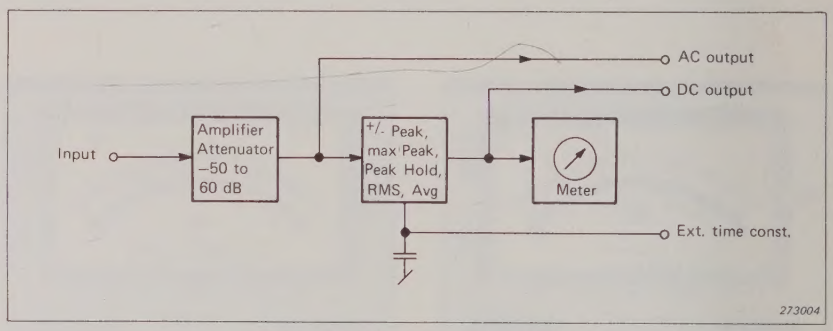


Fig.1. Block diagram of Type 2425

Type 2426 Autoranging Electronic Voltmeter

Voltmeter Type 2426 is identical to Type 2425 in functions and specifications, but is further equipped with an automatic range selector. This makes it extremely simple to operate in that it automatically selects one of twelve ranges from 1 mV to 300 V so that its moving coil meter indicates the correct voltage level without overload. To prevent instability at the points of range change, automatic range shift occurs at a higher voltage when the range is shifted upwards than when it is shifted downwards (hysteresis). The range may also be shifted manually if the measured signal is very unstable, or it may be shifted using a digital control signal, thus permitting remote control as may be required when using the Voltmeter as a calibrated amplifier.

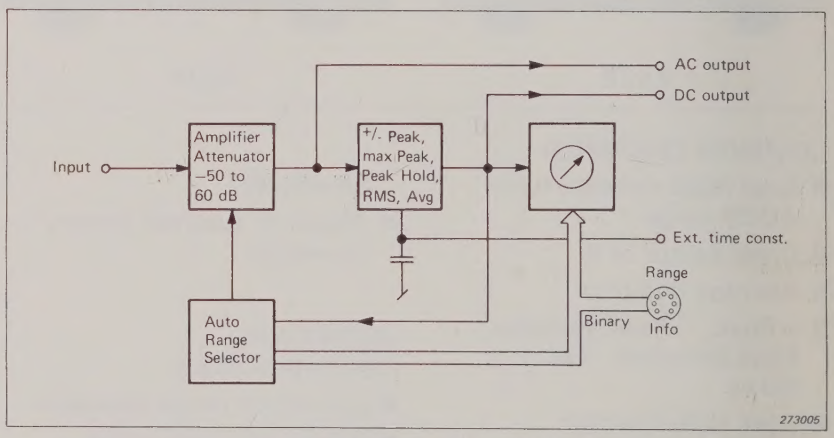


Fig.2. Block diagram of Type 2426

Aside from selecting the correct range, the automatic range selector also operates range indicator lamps. These are located just below the meter scale and indicate the particular V_{FSD} range selected at any given instant. Range information is also available as a digital signal at a DIN socket on the rear panel of the Voltmeter.

Type 2427 Autoranging Digital Voltmeter

Voltmeter Type 2427 is similar to Types 2425 and 2426 in basic functions, but is far more sophisticated in that it makes extensive use of TTL logic and ROMs. It is equipped with a seven segment digital display which simplifies reading of measured values by indicating the correct polarity, decimal place and measurement unit as well as providing an out of range indication. It can display the measured value in volts, dBV (re 1 V), dBm (re 1 mV) and dB μV re (1 μV). The conversion to decibels is performed digitally using a ROM containing the dB values. Errors due to drift and offset, inherent in analog lin/log converters are thus eliminated. The A/D converter is a digital type giving high accuracy and an excellent normal mode rejection of 60 dB in the two lower ranges and 80 dB in the three upper ranges. The autoranging circuit is extremely stable as the range steps are 20 dB with 4 dB of hysteresis for AC signals and 10 dB for DC signals. DC measurements are made over five ranges extending from 100,0 mV to 400 V.

With Voltmeter Type 2427 the reading rate may be adjusted from

2 to 10 readings per second or the reading may be "frozen" by activating a data hold function. For interfacing with a tape punch or computer, there is a 25 pin digital output socket on the rear panel which provides BCD information on the displayed value, sign, measurement unit and range.

Examples of Use

As can be seen in Fig.4, the Voltmeters may be combined with the Phase Meter Type 2971 and the portable Oscilloscope Type 4714. This forms a test set-up for measurement of the voltage, frequency and phase necessary for performance checks, fault finding and repair of electronic equipment.

Phase Meter Type 2971 measures the phase angle (degrees or radians) between two signals of the same frequency. It has a frequency range extending from 2 Hz up to 200 kHz and is equipped with digital as well as analogue read-out and display.

Oscilloscope Type 4714 is a dual trace, portable oscilloscope with measurement bandwidth from DC up to 5 MHz. With its 10:1 input attenuator and a 10:1 oscilloscope probe, signal waveforms with voltages up to 400 V may be displayed.

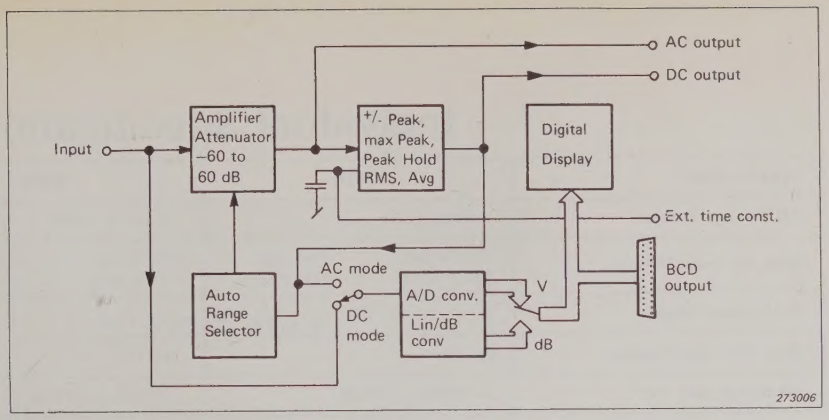


Fig.3. Block diagram of Type 2427

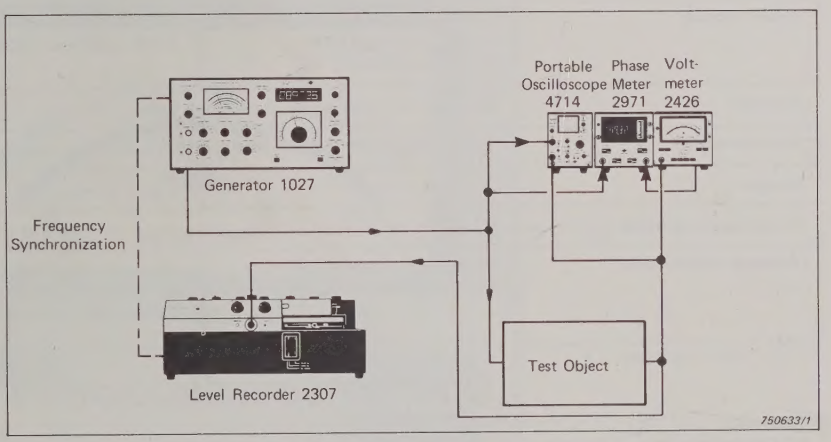


Fig.4. Set-up for phase measurement with 2971

Common Specifications 2425, 2426, 2427

Frequency Range:

	0,5 Hz	2 Hz	20 Hz	0,2 MHz	0,5
Fast			± 0,2 dB	± 0,5 dB	
Slow	± 0,5 dB		± 0,2 dB	± 0,5 dB	

Rectifier Characteristics:
(Also valid for DC output)
Dynamic range: > 40 dB
Accuracy: + 10 dB to —20 dB: ± 0,5 dB
—20 dB to —30 dB: ± 1 dB

Indication:
RMS: Reading within ± 0,5 dB of signals with crest factors up to 5
Averaging time: fast: ~ 270 ms
slow: ~ 3 s
External capacitor: 1 s per 2,5 µF

Peak: + Peak, —Peak, Max. Peak and Peak Hold functions selectable on front panel

Time constants in Peak mode:

Fast	
Rise time constant	Discharge time constant
Reset < 50 µs Hold < 50 µs	2,7 s at full < 0,05 dB/s scale deflec.
Slow	
Reset < 500 µs Hold < 500 µs	30 s at full < 0,005 dB/s scale deflec.

External time constant and rise time via socket on rear panel
Reset Function: Internal by switch on front panel or external via socket on rear panel
Average: Fast (according to standards for VU measurements 2425 and 2426 only) and Slow

Attenuator Accuracy:
Better than 1%

Meter Scale Accuracy:
Better than 1% of full scale deflection (Types 2425 and 2426 only)

Signal Outputs:
1 V ± 2% for full scale deflection (2426:1,1 V)
Max. output: 5,6 Vp
Output Impedance AC: ~ 100 Ω
Min. load impedance: 10 kΩ//200 pF
Output Impedance DC: ~ 10 Ω
Min. load impedance: 1 kΩ

Signal to Noise Ratio: (Ref. 3,16 V RMS)
Range 10 mV to 1000 V: > 60 dB
Range 3 mV: > 50 dB
Range 1 mV: > 40 dB

Inherent Noise:
31,6 µV (typical with max. amplification and input short circuited)

Temperature Range:
5 to 40°C (41 to 104°F)

Individual Specifications

Type Number	2425	2426	2427
AC Voltage Ranges*	1 mV to 300 V	1,1 mV to 350 V	1,00 mV to 380 V
Max. AC Input Voltage	mV Ranges 110 V peak V Ranges 600 V peak	mV Ranges 110 V peak V Ranges 600 V peak	mV Ranges 110 V peak V Ranges 600 V peak
DC Voltage Range	—	—	100,0 mV to 400 V
Max. DC Input Voltage	250 V	250 V	400 V
dB Range (ref. 1 V)*	—60 dB to + 50 dB	—59 dB to + 51 dB	—60 dB to + 52 dB
dBm Range (ref. 0,775 V)*	—60 dB to + 52 dB	—60 dB to + 53 dB	—60 dB to + 54 dB
dB Range (ref. 1 μV)*	—	+ 60 dB to + 171 dB	+ 60 dB to + 172 dB
Input Impedance AC	1 MΩ//47 pF	1 MΩ//60 pF	1 MΩ//70 pF
Amplification	+ 60 dB to —50 dB (in 10 dB steps)	+ 60 dB to —50 dB (in 10 dB steps)	+ 60 dB to —60 dB (in 20 dB steps)
Power Supply	100 V to 240 V AC 9 V A ± 10%, 50 Hz to 400 Hz 2 × 22 V to 35 V DC	100 V to 240 V AC 12 V A ± 10%, 50 Hz to 400 Hz	100 V to 240 V AC 25 V A ± 10%, 50 Hz to 400 Hz
Cabinet	KK 0024, 4/12 of standard 19" rack width		
Dimensions	Height: 132,6 mm (5,2 in) Width: 139,5 mm (5,5 in) Depth: 200,0 mm (7,9 in)		
Weight	2,1 kg (4,7 lbs)	2,3 kg (5,1 lbs)	3,0 kg (6,7 lbs)
Accessories Included	Various fuses, lamps and power cable. Plugs for input and output		
Accessories Available	dBm scale SA 0163 VU scale SA 0168	dBm scale SA 0166 dB μV scale SA 0171 VU scale SA 0169	

* Full scale deflection

Special Specifications 2427

AC Characteristics — Accuracy:

Function	Range	1 kHz		20 Hz to 20 kHz		0,5 Hz to 0,5 MHz	
		% of reading	% of range	% of reading	% of range	% of reading	% of range
RMS and Average	1,00 mV	1%	0,5%	3%	0,5%	6%	1%
	10,00 mV to 1000 V*	1%	0,5%	2%	0,5%	4%	0,8%
+ Peak —Peak	1,00 mV	1%	**10%	3%	**10%	6%	**10%
Max. Peak	10,00 mV to 1000 V*	1%	1%	2%	1%	4%	1,5%

* max. input voltage: 380 V (sine value)
** Peak noise ≅ 10% of range ≅ 100 μV

DC Characteristics:

Range	Accuracy		Input resistance	Typical values	
	% of reading	% of range		Normal mode rejection**	Max. normal mode voltage**
100,0 mV	0,3%	0,5%	1 MΩ	60 dB	12 V pk
1000 mV	0,3%	0,2%	1 MΩ	60 dB	12 V pk
10,00 V	0,3%	0,2%	10 MΩ	80 dB	200 V pk
100,0 V	0,3%	0,2%	10 MΩ	80 dB	400 V pk
1000 V	0,3%	0,2%	10 MΩ	80 dB	400 V pk

* max. DC input voltage = 400 V
** at 50 Hz

Accuracy of Voltage to dB conversion:
± 0,1 dB

Reading Rate:
2 to 10 readings/s

Digital Output:
Signal level: 8-4-2-1 BCD — 13 bits total
Range information: 4-2-1 BCD signal
Sign: + or —
Out of range
Data transfer
Data hold
All outputs TTL compatible, can drive at least four TTL loads

2. CONTROLS

2.1. FRONT PANEL

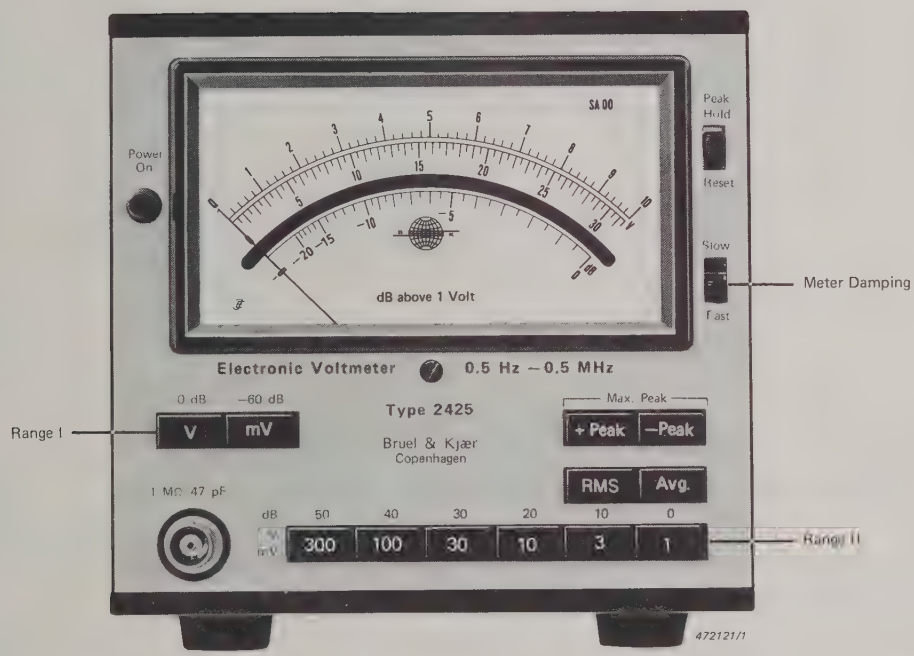


Fig.2.1. Front Panel of the 2425

Power is on with the switch "in" and off with the switch "out". The meter scale lamps light when power is on. Before switching on, check that the voltage selector is set to the correct mains voltage (see section 2.2).

METER:

A moving coil meter with a mirrored back to prevent parallax errors. The meter has three interchangeable scales:

SA 0162. This scale is provided with the instrument. Its two voltage ranges are calibrated from 0 to 10 V and from 0 to 31,6 V. Its dB scale is calibrated from —20 to 0 dB.

SA 0163. Available on separate order. Is similar to SA 0162 but includes calibration for dBm measurements. The dBm scale is calibrated from —20 to + 2 dBm (re 0,775 V in 600 Ω which corresponds to 1 mW).

SA 0168. Available on separate order. Has a "vu" calibrated range from —20 to + 3 vu and a percentage modulation range from 0 to 100%.

To change meter scales, see section 3.1.3.

INPUT:

AC coupled input accepting a standard BNC plug (B & K no. JP 0035), for application of the signal to be measured. It has an input impedance of 1 MΩ//47 pF and can tolerate input voltages as high as 380 V RMS — 600 V Peak (50 to 60 Hz) in the "V" ranges and 80 V RMS in the "mV" ranges. However, for safe operation in accordance with IEC 348 the output current of the signal source should be restricted to 0,7 mA for measurement of voltage levels greater than 42 V.

⚠ **WARNING:** The 2425 is designed to be operated with its signal ground lines and chassis at zero earth potential. Never let its signal ground terminals, socket screens or chassis float at any other potential as this will impair the operating safety of the 2425 and may damage the instrument.

RMS:

Selects true RMS detection of the input AC signal.

Avg.:

Gives average signal detection.

+ Peak:

Gives value of positive peaks.

—Peak:

Gives value of negative peaks.

Max. Peak:

Gives the higher of the positive or negative peak values when both "+ Peak" and "—Peak" are depressed.

METER DAMPING:

"Fast" gives a lower frequency limit (± 0,2 dB) of 20 Hz. Also gives an RMS averaging time of 270 ms and a Peak rise time < 50 μs. When used together with "Avg." the instrument conforms to the standards for vu measurements.

"Slow" gives a lower frequency limit (± 0,5 dB) of 0,5 Hz. "Slow" also gives an RMS averaging time of 3 s and a Peak rise time of < 500 μs.

PEAK HOLD:

"Peak Hold" only functions in the "+ Peak", "—Peak", and "Max. Peak" modes. The decay rate is 0,05 dB/s with the "Fast" meter damping and 0,005 dB/s with "Slow".

"Reset" gives normal (non-hold) operation of the Peak circuits. The decay time is 2,7 s in "Fast" and 30 s in "Slow".

RANGE I:

The "V" and "mV" switches are used together with the RANGE II switches to select the desired range.

RANGE II:

These six pushbuttons give from 0 to 50 dB attenuation in steps of 10 dB and together with the RANGE I switches give the desired range. The values on the pushbuttons are the full-scale voltage values in either V or mV depending on the RANGE I setting. The values above the RANGE I and RANGE II pushbuttons are in dB. The full scale deflection in dB re 1 V equals the sum of the RANGE I and RANGE II dB settings.

2.2. REAR PANEL

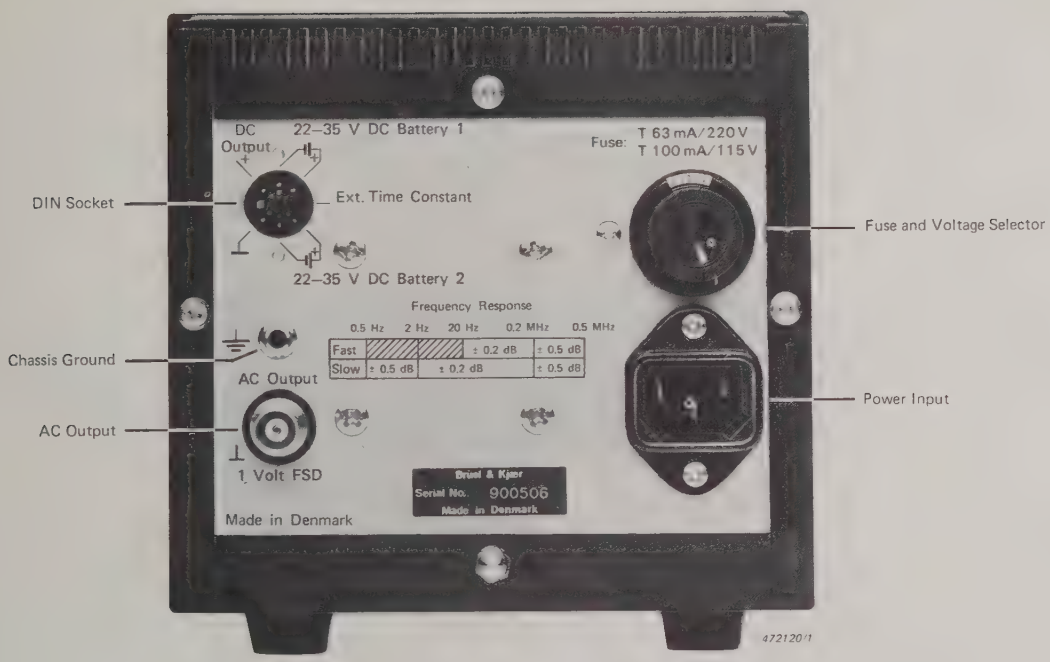


Fig.2.2. Rear Panel of the 2425

DIN SOCKET: A 7-pin DIN socket accepting the DIN plug provided (B & K Type JP 0703). Provides the functions indicated on the rear panel. Connection diagram and further details are given in section 3.5.

AC OUTPUT: BNC socket giving AC signal output voltage. Maximum output voltage is 4,46 V peak with 1 V RMS corresponding to full scale deflection. The output impedance is 100 Ω to be loaded by at least 2 kΩ in parallel with less than 200 pF.

MAINS VOLTAGE SELECTOR AND FUSE: Voltage selector for operation of the 2425 from a 100, 115, 127, 220 or 240 V ± 10% (50 to 60 Hz) AC mains supply. The selector also contains a slow blow mains fuse. Before connecting a supply the mains setting and fuse checks given in section 3.1.3 should be carried out.

MAINS INPUT: Three pin connector accepting the Power Cable AN 0010 provided, for connection to an AC mains supply. Before connecting a supply the mains voltage setting and fuse checks given in section 3.1.3 should be carried out.

3. OPERATION

3.1. PRELIMINARY

3.1.1. Environment and Handling

The Electronic Voltmeter Type 2425 is a robust instrument which is designed to be operated in environments with temperature from + 5 to + 40°C (+ 41 to + 104°F) and humidities up to 90% RH (non condensing). Other than ensuring proper connection of a mains or battery supply and replacement of other scales with the power supply disconnected from the instrument, no special handling precautions are necessary.

3.1.2. Mounting

The 2425 is designed to fit the B & K Module System. It may be used free standing on its four rubber feet or, for easier viewing, its front may be raised by folding down the metal frame attached to its front feet. For mounting in a standard 19-inch instrumentation rack the Metal Frame KK 0014 is available on separate order. This can accommodate

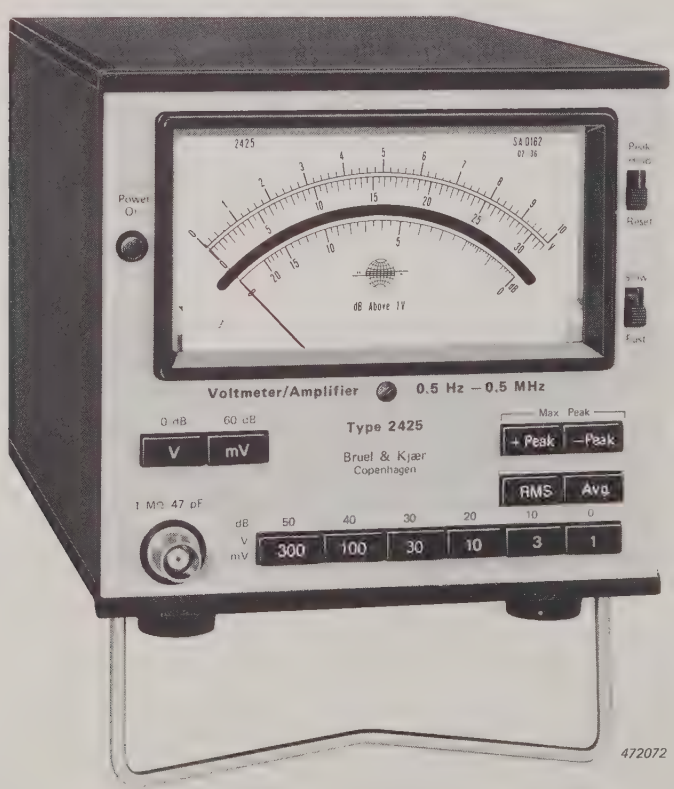


Fig.3.1. The 2425 with front raised using its built-in metal stand

three instruments the same size as the 2425 (such as the Phase Meter Type 2971). For further information on the module system the B & K Short and Main Catalogues should be consulted.

3.1.3. Connection of Mains Supply

Before connecting a mains supply the following checks and adjustments should be carried out to ensure safe operation of the instrument.

Main Voltage Setting

The 2425 may be powered from 100, 115, 127, 220 and 240 V ± 10% (50 to 400 Hz) single phase AC mains lines. To select the correct mains voltage setting, unscrew the knob at the centre of the VOLTAGE SELECTOR on the rear panel and pull the knob and selector disc straight out. Replace the selector disc so that its pin fits into the slot immediately opposite the correct mains voltage setting which should now appear in the window of the disc.

Mains Fuse Rating

The mains fuse is contained in the knob at the centre of the VOLTAGE SELECTOR. For operation from a 100, 115 and 127 V AC supplies the fuse should be a 100 mA slow blow (B & K no. VF 0026), whilst for 220 or 240 V supplies it should be a 63 mA slow blow fuse (B & K no. VF 0047). Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of mended fuses and the short circuiting of fuse holders is prohibited.

Mains Socket Connections

Once the mains voltage setting and fuse have been checked, the mains supply may be connected to the MAINS INPUT socket on the rear panel of the 2425 using the Power Cable AN 0010 provided. To fit a suitable mains plug to the cable see Fig.3.2.

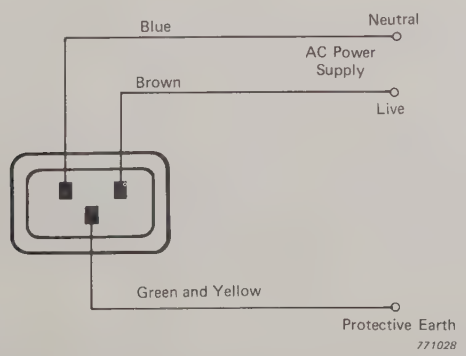


Fig.3.2. Connection of mains supply to MAINS INPUT socket of 2425

For maximum operating safety the protective (green/yellow) conductor of the power cable should be connected to a suitable earth, such as the protective earth contact of a mains socket outlet. The use of extension cables without a protective conductor should be avoided.

In countries where the use of a mains socket outlet without protective conductor is standard, the mains supply should incorporate an authorized earth leakage current circuit breaker.

3.1.4. Meter Scale Installation

Select one of the meter scales listed in section 2.2. Disconnect the instrument from the mains supply and unscrew the fastening screw for the top panel on the rear of the instrument. Then unscrew the two thumb screws which hold the meter light block, slide the block back, and pull the meter scale straight up (Fig.3.3).

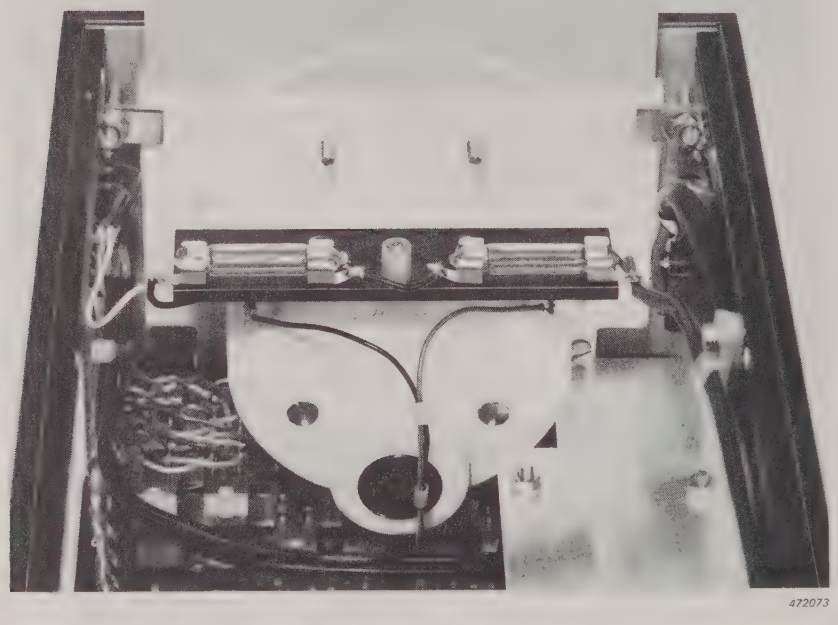


Fig.3.3. Insertion of meter scale

3.1.5. Meter Zero

With power to the instrument turned off, the meter may be zeroed mechanically using the screw directly below the meter scale. Note that when the 2425 is turned on and in the "RMS" mode, it is normal for the meter to have a residual reading of about 1,5% of full-scale deflection, even though no input signal is applied. No attempt must be made to zero this residual out.

3.1.6. Grounding Considerations

Indiscriminate grounding of instruments can introduce ground loop interference. To prevent this it is necessary to ensure that the signal ground line of the 2425 and of other instruments with which it is used is grounded at one point only in the measurement system. To do this without prejudicing the operating safety of the measurement system, proceed as follows:

1. Connect the signal ground lines of all instruments together. This is done automatically through the screens of the input and output cables used to interconnect the instruments.

2. If instruments equipped with a mains socket chassis terminal are employed in the measurement arrangement then check that one and only one of these instruments has its signal ground line connected via chassis to mains ground.

3. If the measurement arrangement is used free standing without the instrument cabinets touching, then ensure that each of the other instruments in the measurement arrangement has its chassis connected to a) mains ground only or b) signal ground only. With instruments having a mains socket chassis terminal, a) is to be preferred.

4. If the measurement arrangement is mounted in a metal instrumentation rack, then ensure that one and only one of the instruments has its signal ground line connected to chassis (and chassis connected to mains ground if equipped with mains socket chassis terminal). If more than one of the instruments has a permanent signal ground chassis connection, then isolate the chasses of these instruments from one another.

If it is necessary to separate the signal ground and chassis of an instrument, this should be done as indicated in its instruction manual. The signal ground and chassis of the 2425 must not be separated.

⚠ **WARNING:** The 2425 is designed to be operated with its signal ground line and chassis at zero earth potential. Never let the signal ground terminal, socket screens or chassis float at any other potential as this will impair the operating safety of the 2415 and may damage the instrument.

3.2. RANGE SELECTION AND METER READING

Always select a range higher than the estimated voltage and then use the RANGE II switches to stepwise (from left to right) increase the gain until an on-scale deflection is obtained. The most accurate reading is obtained when the meter deflection is in the upper 10 dB of the scale.

When changing from the "V" range to the "mV" range, first select the 300 V range, and then push the "mV" button. This prevents severe instrument overload.

To read the meter, choose the scale that corresponds to the range setting. For example, with a range setting of 30 mV, the lower of the two voltage scales should be used — i.e. the scale running from 0 to 30. For dB measurements, the dB level referenced to 1 V is given by the sum of the meter deflection in dB, and the indications above the RANGE I and RANGE II switches. For example, with the 30 mV range selected and with a meter deflection of —5 dB, the dB level is —5 + (—60) + 30 = —35 dB re 1 V.

3.3. VOLTAGE MEASUREMENTS

3.3.1. RMS

Select "RMS" and "Fast" and set the range switches for a meter deflection in the upper 10 dB of the scale. If the meter fluctuates excessively, "Slow" will give a more stable reading. "Slow" must also be used when measuring at frequencies below 20 Hz. The RMS measurements are accurate for crest factors up to 5 (14 dB). The crest factor of the

input signal may be checked by measuring both the Peak and RMS values and determing the ratio of the two.

3.3.2. Average

Select "Avg." and "Fast" and choose the appropriate range. For fluctuating meter deflections or frequencies below 20 Hz, "Slow" should be used. Since the average value is phase dependent, the "Slow" setting gives the most accurate result since it minimizes phase shift at the low frequencies.

3.3.3. Peak

The three types of peak measurements made by the 2425 are defined in Fig.3.4. Although the 2425 does not read Peak-to-Peak directly, this value may be found by adding the "+ Peak" and "— Peak" values.

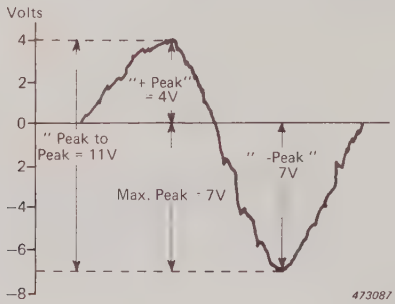


Fig.3.4. Definition of peak measurements made by 2425

To ensure that clipping of the input signal does not occur (especially a potential problem with unsymmetrical signals), the appropriate range should be set in the "Max. Peak" mode and then the desired "+ Peak" or "—Peak" value should be measured in that same range.

The choice of the appropriate METER DAMPING depends on several factors. Since peak values are phase dependent, the "Slow" time constant should give the most accurate value provided the rise time is longer than 500 μs. For shorter rise times down to 50 μs, "Fast" should be used.

Since the input of the 2425 is AC coupled, it must be noted that for unsymmetrical signals, the coupling capacitor will tend to displace the signal such that its average values above and below the zero line are equal. Thus, the true peak values will also be offset. This, however, is only the case for longer duration signals and does not occur on short transients. In either case, "Slow" minimizes this offset.

Transient Signals

To measure the peak value of a transient signal requires some foreknowledge of the signal's approximate amplitude and rise time. Based on this, the 2425 can be set to the appropriate range and the proper time constant can be selected.

1. Select the range including the estimated peak value.

2. Select "Peak Hold". Select "Fast" or "Slow" depending on the estimated rise time of the signal. Make the meter reading.

3. To reset the hold circuit, select "Reset" and "Fast". The meter reading needs only to have fallen below the new anticipated peak value before the next reading may be made. A much faster meter reset may be achieved by connection of an external reset switch to the DIN socket on the rear panel as described in section 3.5.2.

3.3.4. dBm Measurements

For dBm measurements, scale SA 0163 should be used along with the "RMS" detector.

If measuring on a balanced line which must not be disturbed by an unbalance such as that introduced by the unbalanced input of the 2425, Input Transformer TI 0001 must be used (see Chapter 5).

If the line impedance is not 600 Ω a correction factor f must be added to the dBm reading:

$$10 \log_{10} \frac{600}{R}$$

where R is the magnitude of the line impedance. This relation is graphed in Fig.3.5.

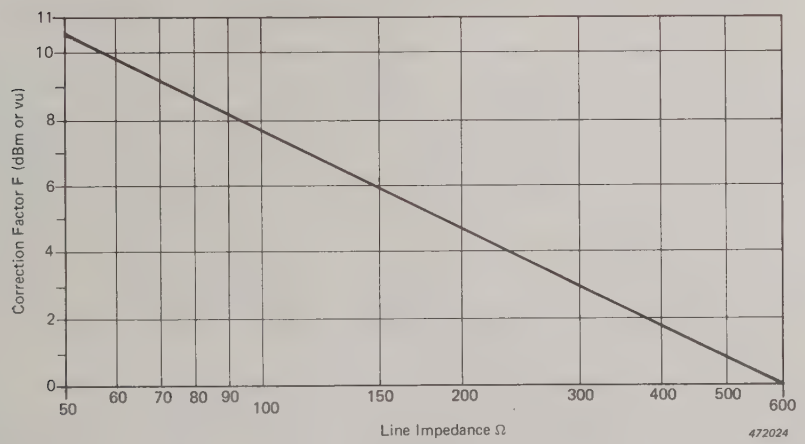


Fig.3.5. Corrections to dBm measurements as a function of line impedance

3.3.5. Volume (vu measurements)

The term "volume" is used to characterize the dynamic amplitude of complex, non-periodic audio frequency signals such as those occuring in speech or music. In standard C 16.5-1961 of the American National Standard Institute (ANSI) the characteristics of a volume indicator are defined. The 2425 conforms to this standard when used in the "Fast" "Avg." mode and when fitted with meter scale SA 0168.

The correct meter reading according to the ANSI standard is determined by "the greatest deflections occurring in a period of about one minute for program waves, or a shorter period (e.g. 5 to 10 seconds for message telephone speech waves, excluding not more than one or two occasional deflections of unusual amplitude".

3.4. AC OUTPUT

The AC output of 1,0 V RMS corresponding to full scale meter deflection is available at the rear panel BNC socket. The output impedance is 100 Ω and the maximum output voltage is 4,46 V peak into a load impedance of at least 2 kΩ. The output is short circuit protected. Maximum capacitive load is 200 pF.

Since the AC output is coupled through a 22 μF capacitor, its lower limiting frequency is determined by the loading of the socket. With a 42 kΩ load, for example, the frequency response due to loading will be —0,5 dB at 0,5 Hz and —3 dB at 0,18 Hz, and with a 14 kΩ Load (which is in the range of input impedances of Level Recorders 2305 and 2307) the frequency response is —0,5 dB at 1,4 Hz and —3 dB at 0,5 Hz. The normal response tolerances of the 2425 and succeeding instruments such as Level Recorders must then be added to these values to give the overall response tolerances. Thus for level recording below 2 Hz, more linear response will be obtained if the DC OUTPUT of the 2425 is used. The gain and dynamic range of the AC OUTPUT are given in Chapter 4.

3.5. USES OF THE DIN SOCKET

3.5.1. DC OUTPUT

The DC output from the rectifier circuits of the 2425 is available between pins 6 (positive) and 7 (ground) of the DIN socket on the rear panel (Fig.3.6).

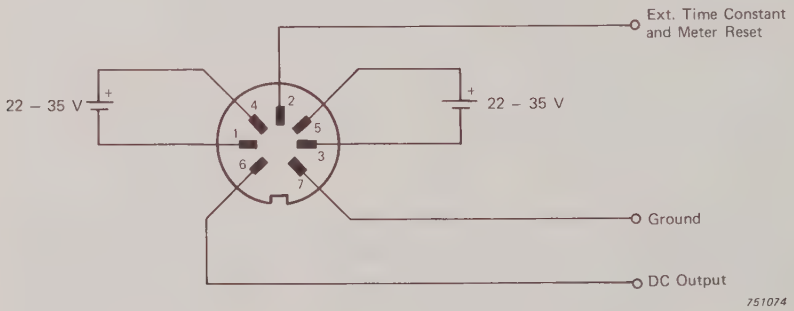


Fig.3.6. Connections to the rear panel DIN socket

The characteristics of the DC output are determined by the positions of the METER DAMPING switch and the signal detector chosen (RMS, Avg. or Peak) as outlined in the Specifications. The output impedance is less than 10 Ω with 1,0 V DC corresponding to full scale deflection. The dynamic range of the DC output is + 10 dB to —30 dB re 1 V.

The DC output is suited for direct connection to Level Recorders Type 2305, 2306, 2307 or 2309 or other monitoring equipment with an input impedance of at least 2 kΩ.

3.5.2. External Time Constants and Meter Reset

The "Ext. Time Constant" pin of the DIN socket on the rear panel of the 2425 may be used for (1) external selection of averaging times for RMS measurements, (2) external selection of decay times for Peak measurements, and (3) external meter reset. It should be noted that these connections affect only Peak and RMS measurements, and not Average.

External RMS Averaging Time

The averaging time of the RMS circuit will be increased by 1 second for every 2,5 μF capacitance connected across pin 2 (positive) and pin 7 (ground) of the DIN socket (Fig.3.5). Thus the total averaging time will be equal to the sum of the internal averaging time (0,27 s for "Fast", 3 s for "Slow" METER DAMPING) and the external averaging time (1 s per 2,5 μF). For example, for the "Slow" METER DAMPING, a 10 μF capacitor will increase the averaging time of the RMS circuit from 3 to 7 seconds.

External Peak Decay Time

The decay time of the "Peak" circuits of the 2425 may be changed by the connection of an external capacitor or resistor to pins 2 and 7 of the DIN socket (Fig.3.6).

The decay time will be increased by 10 seconds for every 2,5 μF capacitance connected. Thus the total decay time equals the sum of the internal decay time (2,7 s for "Fast", 30 s for "Slow" METER DAMPING) and the external decay time (10 s/2,5 μF). For example, for the "Slow" METER DAMPING, a 10 μF capacitor will increase the decay time from 30 to 70 seconds. Only high-quality, low leakage capacitors should be used. The peak rise time will also be increased proportional to the external capacitance.

The decay time for peak measurements may also be decreased by connecting a resistor between pins 2 and 7 of the DIN socket. The decay time (τ) is then given by the formula:

$$\tau = \tau_i \frac{R_e}{R_e + R_i}$$

where τ_i is the internal decay time constant of either 2,7 s ("Fast") or 30 s ("Slow"), R_i is equal to 3,9 MΩ and R_e is the value of the external resistance. This relationship is graphed in Fig.3.7 for the "Slow" METER DAMPING. It should be noted that accurate Peak measurements can only be guaranteed for decay time constants equal to or greater than 2,7 seconds.

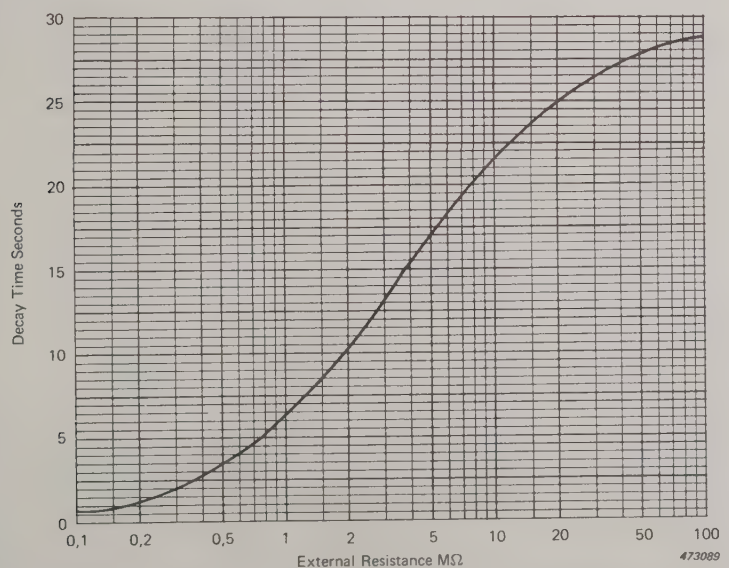


Fig.3.7. Peak decay time for various external resistances using the "Slow" METER DAMPING

Remote Meter Reset

The meter of the 2425 may be reset by momentarily shorting pins 2 and 7 of the DIN socket through a 1 kΩ resistor. The reset time will be longest in the "Slow" mode and shortest in the "Fast" mode. It should be noted that the external reset is different than the internal "Reset" of the PEAK HOLD switch.

The internal reset is considerably slower and only functions in the Peak modes while the external reset also functions in the RMS mode.

3.5.3. Battery Operation

If desired, the 2425 may be operated by two batteries from 22 to 35 V connected as shown in Fig.3.6. The 2425 is protected from accidental polarity reversal of the batteries and draws a maximum current of 45 mA from each battery under normal operation. With battery operation, the meter scale lamps are not lit and the POWER ON switch is not operative. Therefore, the batteries should be disconnected when the 2425 is not in use in order to conserve battery power.

4. OPERATIONAL CHARACTERISTICS

4.1. DYNAMIC RANGE AND GAIN

The dynamic range of the AC amplifier of the 2425 referenced to maximum output voltage (4,46 V peak) is specified as better than 40 dB in the 1 mV range, 50 dB in the 3 mV range, and better than 60 dB in all other ranges. In practice the dynamic range alternates between a minimum of 60 dB beginning with the 10 mV range and 70 dB beginning with the 30 mV range as shown in Table 4.1. Also shown is the overall instrument gain in each range.

	mV						V					
Range	1	3	10	30	100	300	1	3	10	30	100	300
Gain (dB)	+60	+50	+40	+30	+20	+10	0	−10	−20	−30	−40	−50
Dynamic Range (dB)	40	50	60	70	60	70	60	70	60	70	60	70

760001

Table 4.1. Gain and dynamic range of the 2425

4.2. FREQUENCY CHARACTERISTICS

The frequency response of the AC amplifier of the 2425 is shown in Fig.4.1. The low frequency response is limited by the coupling networks selected by the METER DAMPING switch. The high frequency response is given a rapid roll-off above 500 kHz by appropriate choice of feedback in the operational amplifiers used throughout the AC amplifier. The low frequency response limits are 0,5 Hz (± 0,5 dB) in the "Slow" mode and 20 Hz (± 0,2 dB) in the "Fast" mode.

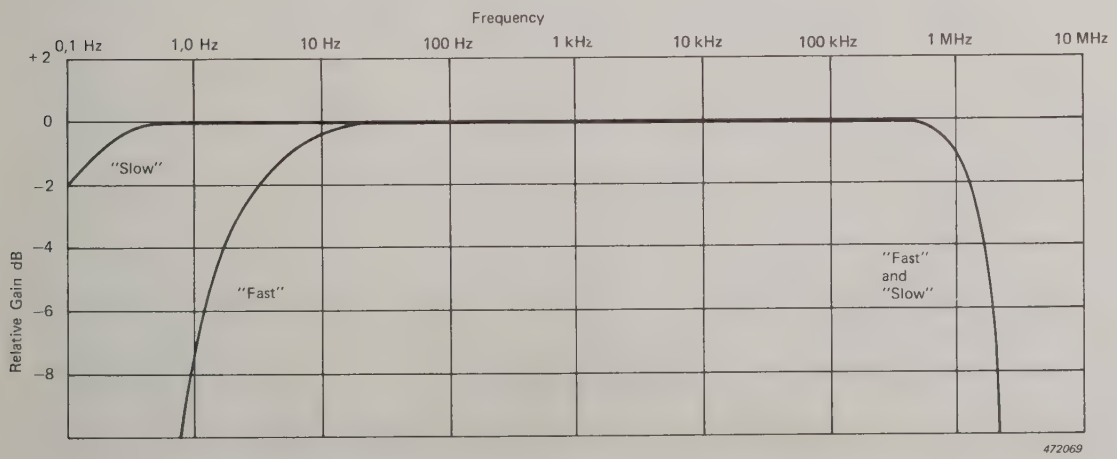


Fig.4.1. Frequency response of the AC amplifier of the 2425

The high frequency response limit is 500 kHz (± 0,5 dB). Thus the AC amplifier is capable of amplifying square waves without any appreciable rounding of the corners at frequencies up to 50 kHz.

4.3. PHASE CHARACTERISTICS

The phase characteristics of the AC amplifier of the 2425 are shown in Fig.4.2. As with the frequency response, the low frequency phase characteristics are determined by the position of the METER DAMPING switch.

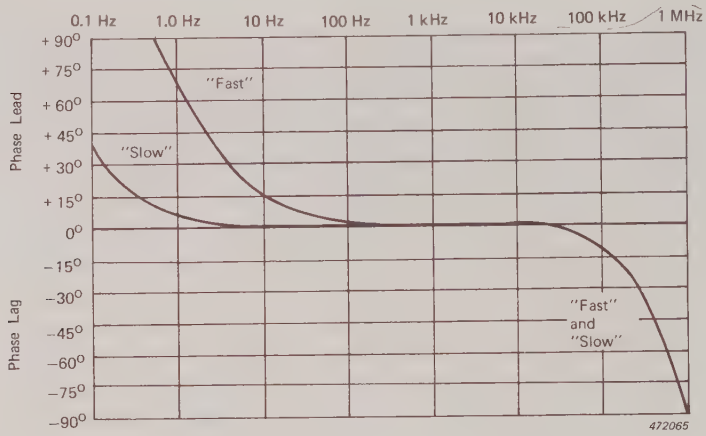


Fig.4.2. Phase response of the AC amplifier of the 2425

The phase response of the 2425 will not affect the accuracy of the measurement of RMS signals of a sinusoidal or complex nature. Nor will Peak or Average measurements of sinusoidal signals be affected. However, for Peak and Average measurements of complex waveforms, errors may arise.

The phase response of the amplifier affects the measurement accuracy of Peak and Average values of a square wave primarily at extremely low and high frequencies. This is illustrated in Fig.4.3. At low frequencies, a "sag" in the waveform occurs due to the phase of the low frequency components leading the fundamental. However, good square wave reproduction will occur at approximately 10 times the lower limiting frequency. Hence, essentially "sag-free" square waves will be reproduced above 5 Hz in the "Slow" mode and above 200 Hz in the "Fast" mode.

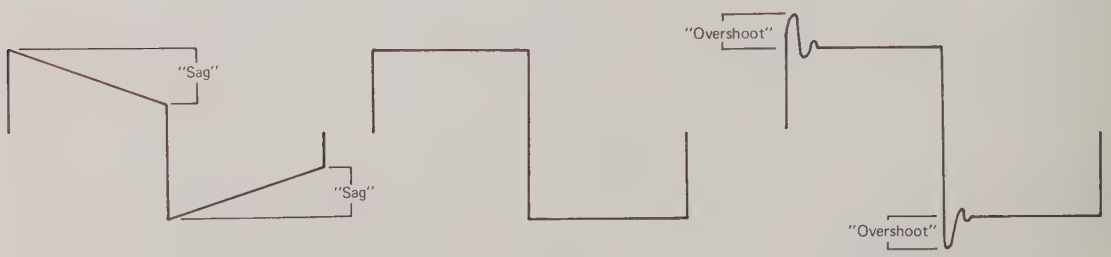


Fig.4.3. Influence of phase response on square waves

The high frequency phase characteristics become a factor when signals with a fast rise time are to be measured or amplified. If the rise time of the signal is less than 2,5 μs the amplifier will overshoot or "ring" as also shown in Fig.4.3. This overshoot will then change the peak value of the signal giving rise to a measurement error. This type of error is avoided with signal rise times greater than 2,5 μs.

The magnitude of the Peak and Average measurement errors as compared to the RMS indication is given in Fig.4.4.

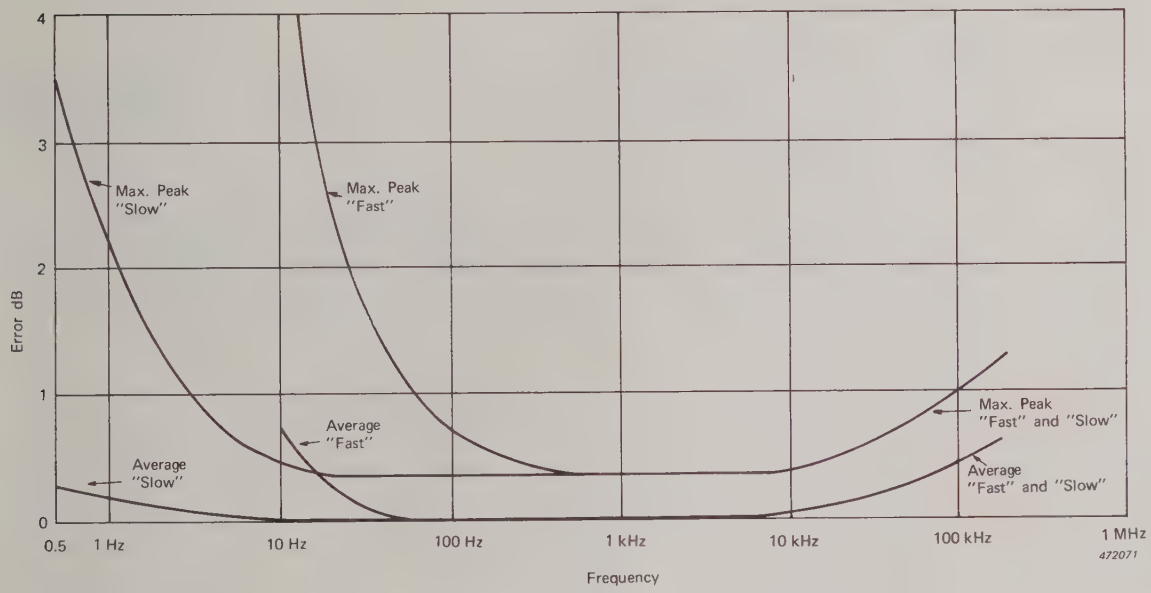


Fig.4.4. Accuracy of Peak and Average indications of the 2425 for a square wave as compared to the RMS indication

5. ACCESSORIES

5.1. INPUT TRANSFORMER TI 0001

For voltage or vu measurements with the 2425 on balanced lines, or balanced amplifiers, it is necessary to use the Input Transformer TI 0001 which is available from B & K on separate order.

The transformer (Fig.5.1) provides a balanced input to the 2425 which is symmetrical with respect to ground. Using the INPUT IMP. switch of the transformer, an input impedance of 20 kΩ or 600 Ω can be selected. A third position of the switch enables the midpoint of the balanced inputs to be connected to the transformer's casing.

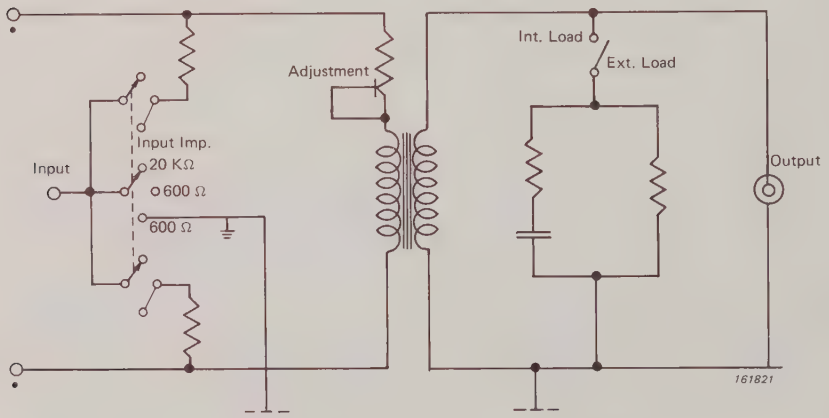


Fig.5.1. Input Transformer Type TI 0001

To ensure correct loading of the transformer's secondary when its output is connected to the INPUT of the 2425 the transformer is provided with a 25 kΩ load which may be selected using its INT. LOAD switch.

The frequency and phase characteristics of the transformer are shown in Figs.5.2 and 5.3, while the maximum input voltage ratings for different signal frequencies are shown in Fig.5.4. If signals containing a DC component are to be measured then a 1 μF capacitor should be connected in series with each of the transformer's balanced inputs for DC blocking purposes.

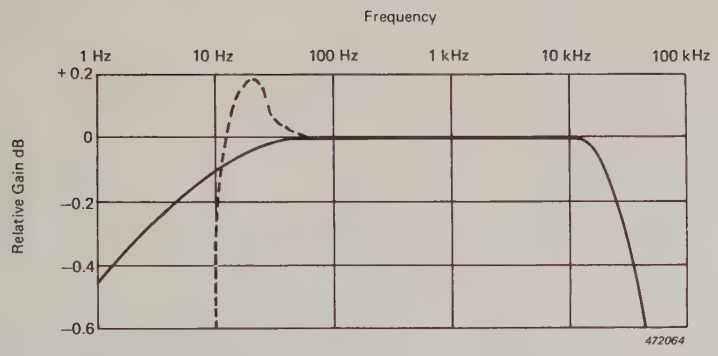


Fig.5.2. Frequency characteristics of input Transformer TI 0001. The dashed curve gives low frequency response with a 1 µF capacitor connected in series with each of the balanced inputs

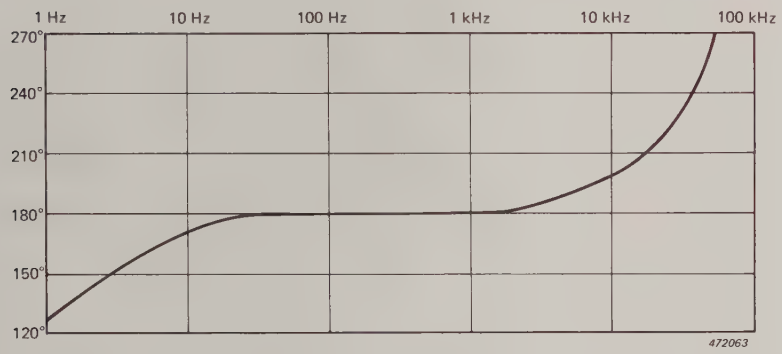


Fig.5.3. Phase characteristics of Input Transformer TI 0001

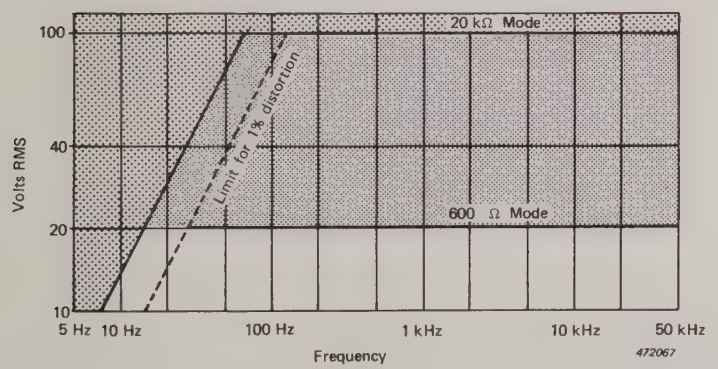
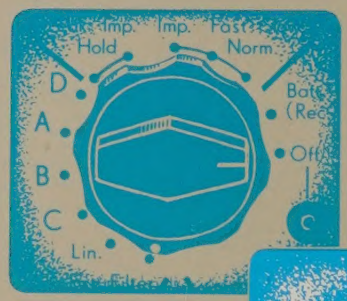
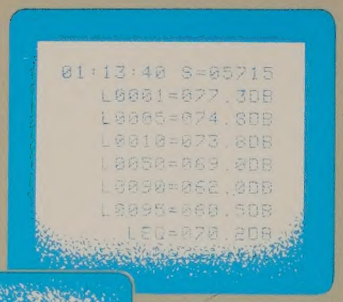


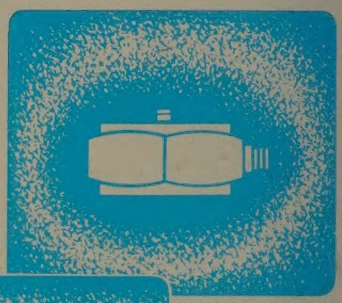
Fig.5.4. Maximum input voltage ratings of Input Transformer TI 0001

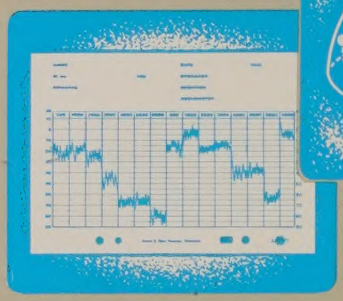
6. SERVICE AND REPAIR

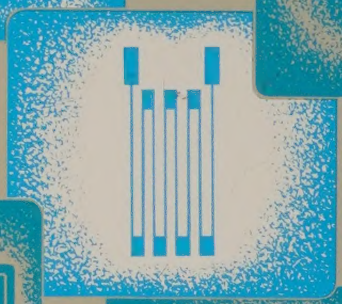
The 2425 is designed and constructed to provide the user with many years of reliable operation. However, should a fault occur which impairs its correct function and operating safety, then it should be immediately disconnected at the mains source and be secured against unintended operation. For repair consult the separate Service Instruction Manual available for the 2425 or contact your local B & K service representative. Under no circumstances should repair be attempted by persons not qualified in the service of electronic instrumentation.

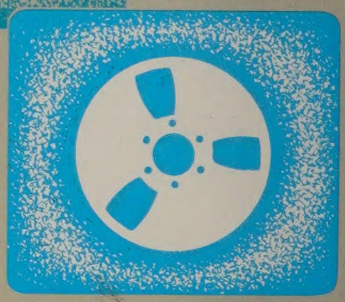


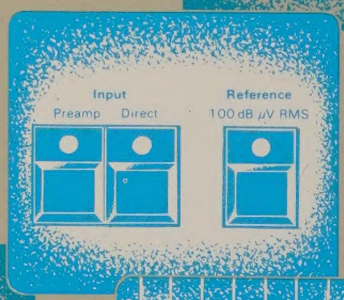


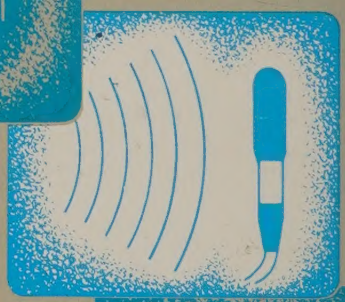


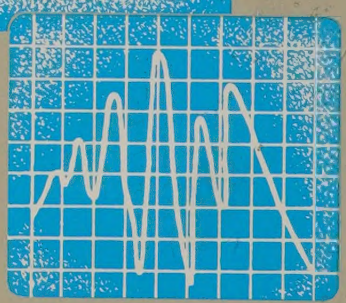


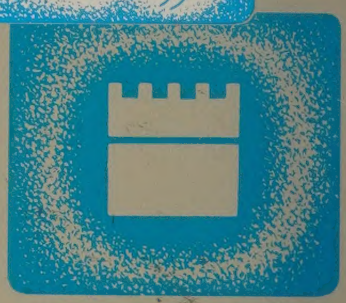












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